

CARDIAX™: Computer-Aided Review of Diagnosis Involving Auscultation, X-ray (and EKG)

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Third year medical students at the University of Michigan have a required cardiology exercise created by one of the authors (RDJ) as part of their Medicine clerkship. Students work up 7 real patient cases by reading a short patient vignette, viewing and interpreting chest x-rays and EKGs, and listening to heart sounds on a cassette recorder. A short write up with interpretations and diagnoses must be turned in weekly for grading; these are reviewed in a conference with provision of feedback on common diagnostic errors, and so on. Logistical considerations prompted relocation and redesign of the exercise, resulting in the development of CARDIAX™.

This software is the result of a collaboration between the Internal Medicine faculty (RDJ) and the Learning Resource Center's (LRC) Medical Instructional Computing Group and Media Services Unit. The project team has created a Macintosh-based, Authorware Professional™ multimedia program combining text with digitized sound, images [such as chest x-rays and EKGs,] Macro Mind Director™ animations, and QuickTime video movies. The program will be delivered both in the LRC computer facilities and in the hospital via the Medical School's Health Sciences Network. The major objective of the CARDIAX™ program is to demonstrate that accurate "low tech" observation at the bedside with attention to physical exam, history, chest x-ray, EKG and simple routine labs is critical to cost-effective selection of "high tech" diagnostic and therapeutic procedures.

The first of 15 problem-based cases planned for CARDIAX™ was recently completed. A brief history and video vignette of an actual patient, Mrs. W, with suspected Coronary Artery Disease is presented, followed by the results of the physical exam (PE). A QuickTime movie enables the Instructor to demonstrate proper auscultatory technique, and allows the student to hear actual heart sounds. Students are then required to listen to the heart sounds and interpret them in a highly structured fashion: schematics of the sounds are

presented and the student is prompted to select the correct choice. Immediate feedback is provided, and the student may not proceed before choosing the correct answer. On subsequent screens, the heart sound is further characterized and correlated with a phonocardiogram. Animations make clear the various components of the heart sound, and electronic manipulation makes it possible to highlight relevant clicks, snaps, etc. Students are thereby forced to listen, characterize and explain the heart sounds before moving on in the work-up. Digitized chest x-rays are provided for interpretation, requiring the student to point and click on any abnormalities, which are highlighted with appropriate explanation. Useful comparisons with normal images correlated disease states are provided for reference. The EKG is similarly presented. Additional resources for comparisons are provided in pull-down menus, which allow the student access to databases of various heart sound schematics, chest x-rays, heart sounds and EKGs.

Following completion of the preliminary PE, the student must formulate a differential diagnosis and choose a path for continuation of the workup in order to confirm or rule out competing diagnoses. Additional diagnostic options include a stress EKG, echocardiogram, or cardiac catheterization; however, these are placed in the perspective of holistic medical care. Throughout the extended workup the student proceeds within the learning environment of CARDIAX™. At the conclusion of the case a summary reviews the highlights of the workup and important decision points, provides feedback to the student, and reports the patient's reaction to the final diagnosis and proposed treatment plan.

The remaining cases will present a variety of disease states, forming a matrix which will give the student a comprehensive understanding of basic cardiovascular medicine. The program format will also allow the introduction of relevant ethical, medico-legal, historical and socio-economic issues into many of the cases.